CHAPTER 3. TAKEOFF AND LANDING MINIMUMS

300. APPLICATION. The minimums specified in this chapter are the lowest which can be approved at any location for the type facility concerned.

301. - 309. RESERVED.

Section 1. General Information

310. ESTABLISHMENT. The minimums established for a particular airport shall be the lowest permitted by the criteria contained in this Handbook. Each procedure shall specify minimums for the various conditions stated in the procedure; i.e., straight-in, circling, alternate, and takeoff, as required. The elements of minimums are the MDA (or DH) and the weather. The weather minimums shall include the visibility required by the procedure, and may include a ceiling value which is equal to or greater than the height of the MDA or DH above airport elevation. Where ceilings are not specified, the height of the straight-in MDA or DH above the highest elevation in the touchdown zone (or the airport elevation in circling approaches) shall be shown on the procedure. Alternate minimums, when specified, shall be stated as ceiling and visibility. Takeoff minimums, when specified, shall be stated as visibility only, except where the need to see and avoid an obstacle makes it necessary to specify a ceiling value. Military services may specify alternate and takeoff minimums in separate directives.

311. PUBLICATION. Minimums should be published for each approach category which can be accommodated at the airport. Where the airport landing surface is not adequate, or other restrictions exist which prohibit certain categories of aircraft from making an instrument approach at an airport, "NA" (not authorized) shall be entered in lieu of the minimums values. Approach Category "E" minimums should be published only on high altitude procedures, except where a special requirement exists for their publication on other procedures. Minimums on military procedures shall be published as prescribed by the appropriate Service.

312. - 319. RESERVED.

Section 2. Altitudes

320. MINIMUM DESCENT ALTITUDE (MDA). The MDA is the lowest altitude to which descent shall be authorized in procedures not using a glide slope. Aircraft are not authorized to descend below the MDA until the runway environment (see glossary) is in sight, and the aircraft is in a position to descend for a normal landing. The MDA shall be expressed in feet above MSL and is determined by adding the required obstacle clearance to the MSL height of the controlling obstacle in the final approach segment and circling approach area for circling approaches.

321. MDA FOR STRAIGHT-IN APPROACH. The MDA for a straight-in approach shall provide at least the minimum required clearance over obstacles in the final approach segment. It shall also be established high enough to insure that obstacles in the missed approach area do not penetrate the 40:1 missed approach surface (see Paragraph 274). The MDA shall be rounded off to the next HIGHER 20-foot increment. For example, 2104 feet becomes 2120.

* 322. MDA FOR CIRCLING APPROACH. The height of the circling MDA above the airport (HAA) shall not be less than that shown in paragraph 351. In addition, the MDA shall provide at least the minimum required obstacle clearance in the final approach segment and the circling approach area. It shall also meet the missed approach requirements specified in paragraph 321. The MDA shall be rounded to the next higher 20-foot increment. For example, 2,109 feet shall become 2,120. The published MDA for circling shall not be below the straight-in MDA.

323. MINIMUMS ADJUSTMENTS. Raising the MDA or DH above that required for obstacle clearance may be necessary under the following conditions: *

a. Precipitous Terrain. When procedures are designed for use in areas characterized by precipi-

tous terrain, in or outside of designated mountainous areas, consideration must be given to induced altimeter errors and pilot control problems which result when winds of 20 knots or more move over such terrain. Where these conditions are known to exist, required obstacle clearance in the final approach segment should be increased. Procedures specialists and approving authorities should be aware of the hazards involved and make appropriate addition, based on their experience and good judgment, to limit the time in which an aircraft is exposed to lee-side turbulence and other weather phenomena associated with precipitous terrain. This may be done by increasing the minimum altitude over the intermediate and final approach fixes so as to preclude prolonged flight at low altitudes. User comments should be solicited to obtain the best available local information.

* **b. Remote Altimeter Setting Source (RASS).** When the altimeter setting is obtained from a source more than 5 NM from the airport reference point (ARP) for an airport, heliport, or vertiport, increase the ROC by the amount of RASS adjustment for the MSA, initial, intermediate, and final segments (except precision final), and circling areas. For precision approaches, increase the DH by the amount of RASS adjustment. The following formula shall be used to compute the adjustment in feet:

$$\text{Adjustment} = 2.30d_R + 0.14e$$

where "d_R" is the horizontal distance in nautical miles the altimeter source is remoted from the ARP; and "e" is the terrain elevation differential in feet between the lowest and the highest elevation points contained within the elevation differential area (EDA).

(1) Determination.

(a) Elevation Differential Area (EDA). The EDA is defined by an area 5 NM each side of a line connecting the ARP and the RASS, and including a circular area enclosed by a 5 NM radius at each end of this line. See figures 37B and 37C. This is a minimum standard and should be used with caution. Provisions for non-homogeneous weather and terrain elevation differentials are included in this formula.

(b) Excessive Distance/Differential. A remote altimeter setting source shall not be authorized for a remoted distance (d_R) greater than 75 NM, or for an elevation differential (e) greater than 6,000 feet.

(2) Application.

(a) Both distance and elevation differential together comprise the RASS adjustment. RASS adjustment shall be applied to:

MSA	Missed Approach
Initial	Circling
Intermediate	Holding
Final Approach (except precision ROC)	DH

RASS adjustment does not apply to enroute, feeder routes, or segment/areas based on enroute criteria.

(b) Point-in-Space Approach (PINSA). When the MAP is more than 5 NM from the altimeter setting source used for a PINSA, RASS adjustment shall be applied by defining an EDA from the altimeter setting source to the MAP, and enclose the same as in paragraph 323b(1)(a), above.

(c) Minimum Reception Altitude (MRA). Where an MDA is dictated by the MRA, the MRA shall be increased by the amount of the RASS adjustment factor.

(d) Procedures shall be annotated in all cases where the altimeter is based on a remote source. Case 1 (full time) "Use Boise, Idaho, altimeter setting." In this case, the adjustment shall be included in the published minimums. Case 2 (Part Time) "When control zone not in effect, use Boise, Idaho, altimeter setting and increase all DH's/MDA's _____ feet. When neither available, procedure not authorized."

(e) To preclude possible affect on human factors, only one RASS should be published for an airport. *

c. Excessive Length of Final Approach. When a final approach fix is incorporated in the procedure, and the distance from that fix to the nearest landing surface exceeds 6 miles, the required obstacle clearance in the final approach segment shall be increased at the rate of 5 feet

for each one-tenth of a mile over 6 miles. Where a stepdown fix is incorporated in the final approach segment, the basic obstacle clearance may be applied between the stepdown fix and the MAP provided the fix is within 6 miles of the landing surface. These criteria are applicable to nonprecision approach procedures only.

324. DECISION HEIGHT (DH). The decision height applies only where an electronic glide slope provides the reference for descent, as in ILS or PAR. The decision height is the height, specified in feet above MSL, above the highest runway elevation in the touchdown zone at which a missed approach shall be initiated if the required visual reference has not been established. Decision heights shall be established with respect to the approach obstacle clearance requirements specified in the ILS and PAR chapters, and shall NOT be less than the HAT shown in the appropriate table in paragraph 350.

325.-329. RESERVED

Section 3. Visibilities

330. ESTABLISHMENT OF VISIBILITY MINIMUMS.

a. Straight-in minimums for NONPRECISION approaches shall be established for an approach category when:

(1) The final approach course-runway alignment criteria have been met, AND

(2) The Visibility requirements of paragraph 221 are met, AND

(3) The height of the MDA above the touchdown zone (TDZ) and the associated visibility are within the tolerances specified in paragraph 331, AND

(4) The descent gradient from the final approach fix to the runway does not exceed the maximum specified in the applicable facility chapter of this Handbook.

b. Straight-in minimums for PRECISION approaches shall be established for an approach category when the final approach course-runway alignment criteria have been met.

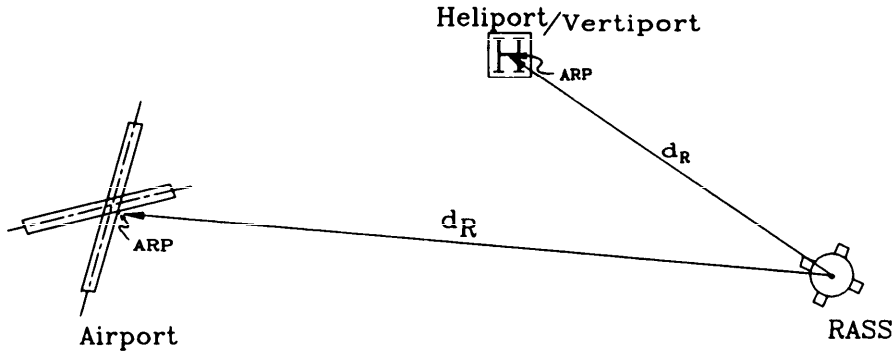
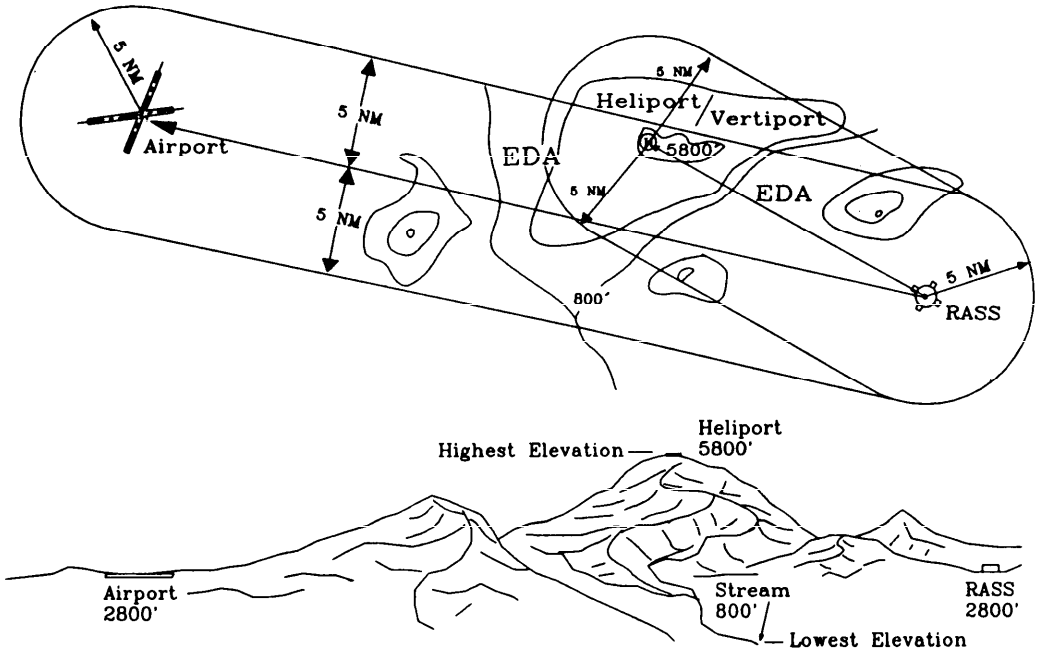


Figure 37B. DISTANCE REMOTED (d_R)



EXAMPLE – ELEVATION DIFFERENTIAL: Airport -- e=5800'–800'=5000'
Heliport/Vertiport – e=5800'–800'=5000'

Figure 37C. ELEVATION DIFFERENTIAL AREA (EDA)

Table 6. EFFECT OF HAT/HAA ON VISIBILITY MINIMUMS

HAT/HAA (ft.)	250-320	321-390	391-460	461-530	531-600	601-670	671-740	741-810	811-880	881-950	951 & above
CAT A	1 mi									1¼	
CAT B	1 mi							1¼			1½
HAT/HAA	250-400		401-500		501-600	do	do	do	do	do	do
CAT C	1 mi		1¼		1½	1¾	2	2¼	2½	2¾	3
HAT/HAA	250-341	342-426	427-511		512-600	do	do	do	do	do	do
CAT D	1 mi	1¼	1½		1¾	2	2¼	2½	2¾	3	
HAT/HAA	250-320	321-390	391-460	461-530	531-600	do	do	do	do	do	do
CAT E	1 mi	1¼	1½	1¾	2	2¼	2½	2¾	3		

c. The minimum visibility prior to applying credit for lights shall be the higher of the following values:

(1) The MAP to threshold distance (where the MAP is reached before the threshold).

(2) Those given in Table 6 or 6a (paragraph 331).

This subparagraph does not apply to a procedure where the MAP is more than 2 statute miles from the airport and the procedure is noted, "Fly visual to airport" in which case the required visibility shall be at least 2 miles, but not less than the visibility specified in Table 6.

d. When straight-in minimums are not authorized, only circling MDA's and visibilities will be established. In establishing circling visibility minimums, paragraph 331 applies. These minimums shall be no lower than those specified in paragraph 351.

e. Circling landing minimums shall NOT be lower than straight-in landing minimums.

331. EFFECT OF HAT/HAA AND FACILITY DISTANCE ON STRAIGHT-IN AND CIRCLING VISIBILITY MINIMUMS. The minimum standard visibility required for the pilot to establish visual reference in time to descend safely from the MDA and maneuver to the runway or airport varies with the aircraft category, the HAT/HAA, and the accuracy of the navigation system. Table 6 specifies the minimum standard visibility as determined by HAT/HAA. Table 6A specifies the minimum standard visibility as determined by distance from the facility to the runway.

NOTE: *The higher of the visibilities derived from the table applies.*

Table 6A. EFFECT OF FACILITY DISTANCE ON VISIBILITY MINIMUMS

NAVAID TYPE	CAT	DISTANCE FROM FACILITY TO MAP OR RWY THLD (whichever is farther)				
		0-10	Over 10-15	Over 15-20	Over 20-25	Over 25-30
ASR	A	1	1	1		
	B	1	1 ¼	1 ¼		
	C	1	1 ¼	1 ¼	N/A	N/A
	D-E	1	2	2		
NDB, DF	A	1	1			
	B	1	1 ¼			
	C	1	1 ¼	N/A	N/A	N/A
	D-E	1	2			
VOR, TACAN LOC SDF LDA	A	1	1	1	1	1
	B	1	1	1	1 ¼	1 ¼
	C	1	1	1 ¼	1 ¼	1 ¼
	D-E	1	1 ¼	1 ¼	1 ¾	2

* **332. EFFECT OF OBSTACLES.** Visibility minimums must be at or above certain values when obstacles penetrate a 20:1 or 34:1 slope commencing 200 feet outward from the landing threshold and overlying the first 10,000 feet of an area which is the same as the ILS/PAR final approach area. To establish a visibility:

a. Lower than 1 mile, no obstacle shall penetrate the 20:1 slope.

b. Lower than 3/4 mile, no obstacle shall penetrate the 34:1 slope. *

333. RUNWAY VISUAL RANGE (RVR). Runway visual range is a system of measuring the visibility along the runway. It is an instrumentally derived value that represents the horizontal distance a pilot will see down the runway from the approach end. It is based on the sighting of either high intensity runway lights or the visual contrast of other targets, whichever yields the greater visual range.

334. RUNWAY REQUIREMENTS FOR APPROVAL OF RVR. RVR may be authorized for straight-in approach procedures and takeoff when * the following requirements are met with respect to the runway to be used. *

a. Transmissometers shall be located in accordance with standards established by the approval authority (e.g., FAA Standard 008).

b. High intensity runway lights spaced at consecutive intervals of not more than 200 feet shall be operative.

c. Instrument runway markings, or touchdown zone and centerline lighting are required for nonprecision approaches. Precision instrument (all-weather) runway markings or touchdown zone and centerline lighting are required for precision approaches. Where sufficient runway lengths are not available to accommodate standard all-weather markings, the approving authority will determine the runway markings to be used. Where required runway markings are not available and credit for lights is not granted, but touchdown zone and centerline lights are available, RVR equal to the visibility minimum without lights is authorized.

335. COMPARABLE VALUES OF RVR AND GROUND VISIBILITY. If RVR minimums for takeoff or landing are prescribed in an instrument approach procedure but RVR is not reported for the runway of intended operation, the RVR minimums shall be converted to ground visibility in accordance with Table 7, and observed as the applicable visibility minimum for takeoff or landing on that runway.

Table 7. COMPARABLE VALUES OF RVR AND GROUND VISIBILITY.

RVR	VIS (Statute Miles)	RVR	VIS (Statute Miles)
1600	1/4	4500	7/8
2400	1/2	5000	1
3200	5/8	6000	1-1/4
4000	3/4		

336.–339. RESERVED.

Section 4. *Visibility Credit for Lights*

340. GENERAL. Approach lighting systems can "reach out" to the approaching pilot and make the runway environment apparent with less visibility than when such lighting is not available. This section identifies lighting systems and prescribes the operational conditions which must exist in order to reduce straight-in visibility minimums. Table 9 for civil and Table 10 for military in paragraph 350 specify the LOWEST visibility minimums which can result from application of this section.

341. STANDARD LIGHTING SYSTEMS. Listed in Table 8 are the types of standard lighting systems and the required operational coverage for each type.

342. OPERATIONAL CONDITIONS. Credit to reduce straight-in landing minimums for standard or equivalent approach light systems may be given when the following conditions exist for the straight-in landing runway:

a. Markings. The runway must have nonprecision instrument or precision instrument * (all-weather) markings or touchdown zone and centerline lights as specified in paragraph 334c, and * in the directives of the appropriate approving authority.

Table 8. STANDARD LIGHTING SYSTEMS

ABBREV. IFR	LIGHTING SYSTEM	Oper. Coverage (Degrees) Lateral (±)	Vert. (abv Hor)
ALSF-I	Standard approach light system with sequenced flashers	21.0* 12.5#	12.0* 12.5#
ALSF-II	Standard approach light system with sequenced flashers & CAT II mod.	21.0* 12.5#	12.0* 12.5#
SSALS	Simplified short approach light system	21.0	12.0
SSALF	Simplified short approach light system with sequenced flashers	21.0* 12.5#	12.0* 12.5#
SSALR	Simplified short approach light system with runway alignment indicator lights	21.0* 12.5#	12.0* 12.5#
MALS	Medium intensity approach light system	10.0	10.0*
MALSF	Medium intensity approach light system with sequenced flashers	10.0* 12.5#	10.0* 12.5#
MALSR	Medium intensity approach light system with runway alignment indicator lights	10.0* 12.5#	10.0* 12.5#
ODALS	Omnidirectional approach light system	360 #	+2 - +10#
VFR			
REIL	Runway end identifier lights	12.5	12.5
LDIN	Lead-in lighting system (can be * or #)	12.5	12.5
VASI	Visual approach slope indicators	10.0	3.5
	RUNWAY LIGHT SYSTEMS		
HIRL	High intensity runway lights		
MIRL	Medium intensity runway lights		
LIRL	Low intensity runway lights		
TDZ/CL	Touchdown zone and centerline lights		

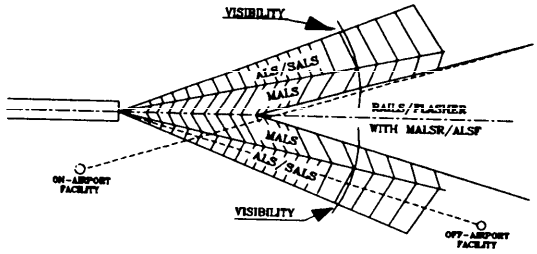
NOTE: Descriptions of lighting systems may be found in Appendix 5 and FAA Handbook 6850.2

**Steady-burning* *#Sequenced flashers*

b. Approach Course. The final approach course must place the aircraft within the operational coverage of the lighting system at a distance from the landing threshold equal to the standard visibility required without lights. See paragraph 330 and * Figure 37D for guidance. *

343. VISIBILITY REDUCTION. Standard visibility requirements are computed by applying the criteria contained in paragraph 331. These requirements may be reduced by giving credit for standard or equivalent approach light systems as follows (see paragraph 341 and Appendix 5):

a. The provisions of paragraph 332, 342, 935, or 1025, as appropriate, must be met.



NOTE: *The final approach course to an 'on-airport' facility transits all approach light operational areas within limits of visibility arc, whereas the final approach course from the 'off-airport' facility may be restricted only to an ALS or SALS for visibility credit.*

* Figure 37D. Application of Lateral Coverage Angles of Table 8, * paragraph 342.

b. Where the visibility required without lights does not exceed one mile, visibility as low as that specified in the appropriate table in paragraph 350 with associated DH or HAT and lighting may be authorized.

c. For civil application, where the visibility required without lights exceeds 1 mile, a reduction of 1/2 mile may be made for SSALR, MALSR or ALSF-1 provided such visibility minimum is not less than that specified in paragraph 350. Reduction for Category D aircraft in NDB approach procedures shall not exceed 1/4 mile or result in visibility minimums lower than 1 mile.

d. For military applications, where the visibility required without lights exceeds 1 mile, a reduction of 1/4 mile may be made for SSALS, MALS, or ODALS, and a reduction of 1/2 mile may be made for ALS, SSALR, or MALSR provided such visibility minimum is not less than that specified in paragraph 350.

e. Where visibility minimums are established in order to see and avoid obstacles, visibility reductions shall not be authorized.

f. Visibility reductions are NOT cumulative.

344. OTHER LIGHTING SYSTEMS. In order for variations of standard systems, and other systems not included in this chapter to receive visibility reduction credit, the operational conditions specified in paragraph 342 must be met. Civil airport lighting systems which do not meet known standards or for which criteria do not exist, will be handled in accordance with the provisions of paragraph 141. Military lighting systems may be equated to standard systems for reduction of visibility as illustrated in Appendix 5. Where existing systems vary from the configurations illustrated there and cannot be equated to a standard system they shall be referred to the appropriate approving authority for special consideration.

345.-349. RESERVED.

Section 5. Standard Minimums

350. STANDARD STRAIGHT-IN MINIMUMS. Tables 9 and 10 specify the lowest civil and military minimums which may be prescribed for various combinations of electronic and visual navigation aids. Lower minimums based on special equipment or aircrew qualifications may be authorized only by approving authorities. Higher minimums shall be specified where required by application of criteria contained elsewhere in this Handbook.

351. STANDARD CIRCLING MINIMUMS. Table 11 specifies the lowest civil and military minimums which may be prescribed for circling approaches. See also paragraph 330c. The MDA established by application of the minimums specified in this paragraph shall be rounded to the next higher 20 feet.

352.-359. RESERVED.

Section 6. Alternate Minimums

360. STANDARD ALTERNATE MINIMUMS. Minimums authorized when an airport is to be used as an alternate airport appear in Table 12. The ceiling and visibility specified shall NOT be lower than the circling HAA and visibility, or as specified in military directives for military operations.

361.-369. RESERVED.

Section 7. Departures

370. STANDARD TAKEOFF MINIMUMS. Where applicable, civil standard takeoff minimums are specified by the number of engines on the aircraft. Takeoff minimums are stated as visibility only, except where the need to see and avoid an obstacle makes a ceiling value necessary. In this case the published procedure shall identify the location of the controlling obstacle. Takeoff minimums for military operations shall be as stated in the appropriate service directives.

Table 9. CIVIL STANDARD STRAIGHT-IN MINIMUMS

	NON-PRECISION APPROACHES					
	NON-PRECISION APPROACHES Approach Facility: LOC, VOR, LDA, NDB, SDF, ASR, or PAR w/o GS					
	APPROACH LIGHT CONFIGURATION	CAT →	A - B - C		D	
		HAT[1]	Vis or RVR		Vis or RVR	
1	NO LIGHTS	250	1	5000	1	5000
2	ODALS	250	3/4	4000	1	5000
3	MALS	250	3/4	4000	1	5000
4	SSALS/SALS	250	3/4	4000	1	5000
5	MALSR	250	1/2[2]	2400	1[3]	5000
6	SSALR	250	1/2[2]	2400	1[3]	5000
7	ALSF-1	250	1/2[2]	2400	1[3]	5000
8	DME Arc Any Light Configuration	500	1	5000	1	5000

[1]Add 50 ft to HAT for VOR without FAF or NDB with FAF.
Add 100 ft to HAT for NDB without FAF.

[2]For NDB approaches, 3/4 mile or RVR 4000.

[3]For LOC, 3/4 mile or RVR 4000.

*

	PRECISION APPROACHES					
	Approach Facility: ILS[4] or PAR					
	APPROACH LIGHT CONFIGURATION	CAT →	A - B - C		D	
		HAT	Vis or RVR		Vis or RVR	
9	NO LIGHTS	200	3/4	4000	3/4	4000
10	MALSR	200	1/2	2400	1/2	2400
11	SSALR	200	1/2	2400	1/2	2400
12	ALSF-1	200	1/2	2400	1/2	2400
13	ALSF-1-TDZ/CL MALSR-TDZ/CL SSALR-TDZ/CL	200	-	1800	-	1800

[4]ILS includes LOC, GS, and OM(or FAF). With Offset LOC(max 3°), HAT is 250 and RVR below 2400 is not authorized. *

NOTE: HIRL is required for RVR. Runway edge lights required for night.

Table 10. MILITARY STANDARD STRAIGHT-IN MINIMUMS

		NO LIGHTS		ALS TDZ/CL		ALS		SSALR		SALS or SSALS		MALSR		MALS		ODALS	
PRECISION																	
HAT	CAT	MILE	RVR [1]	MILE	RVR	MILE	RVR	MILE	RVR	MILE	RVR	MILE	RVR	MILE	RVR	MILE	RVR
100	A-E	1/2	24	—	12	1/4	16	1/4	16	1/4	16	1/2	24	1/2	24	1/2	24
200	A-B	3/4	40	1/2	18	1/2	24	1/2 [2]	24 [2]	1/2	24	1/2	24	3/4	40	1/2	24
200	C,D,E	3/4	40	1/2 [2]	24 [2]	1/2 [2]	24 [2]	1/2 [2]	24 [2]	3/4	40	1/2 [2]	24 [2]	3/4	40	3/4	40
250	A-B	3/4 [4]	40 [4]	1/2	24	1/2 [3]	24 [3]	1/2	24	3/4	40	1/2	24	3/4	40	3/4	40
250	C,D,E	1	50	1/2	24	1/2 [3]	24 [3]	1/2	24	3/4	40	1/2	24	3/4	40	1	50
NON-PRECISION																	
AS REQUIRED	A-B	1	50	1/2	24	1/2	24	1/2	24	3/4	40	1/2	24	3/4	40	3/4	40
AS REQUIRED	C,D,E	1	50	3/4	40	3/4	40	3/4	40	3/4	40	3/4	40	3/4	40	3/4	40
DME ARC APPROACH																	
AS REQUIRED	A-E	1	50	(REDUCTION BELOW ONE MILE NOT AUTHORIZED)													

[1] RVR shown in hundreds of feet, i.e. RVR 24=2400ft.
[2] Minimum length of approach lights is 2000 feet.
[3] For non-standard ALS lengths of:
a. 2400 to 2900 feet, use SSALR.
b. 1000 to 2300 feet, use SSALS.
[4] When the MAP is located 3/4 mile or less from the threshold.

INSTRUCTIONS FOR ESTABLISHING MILITARY STRAIGHT-IN MINIMUMS
(Use Table 10)

STEP 1.	Determine the required DH or MDA by applying criteria found in the appropriate facility chapter of this Handbook.
STEP 2.	Determine the height above touchdown zone elevation (HAT).
STEP 3.	Determine the visibility value as follows: a. Precision Approaches. (1) HAT 250 feet or less. Enter "precision" portion of Table 10 at HAT value for aircraft approach category. Read across table to determine minimum visibility for the appropriate light system. If the HAT is not shown on the table, use the next higher HAT. (2) HAT greater than 250 feet. Use the instructions for the non-precision minimums in. b. below Paragraph 331 does not apply. b. Non-Precision Approaches. Determine the basic visibility by application of criteria in paragraphs 330 and 331. If the basic visibility is 1 mile, enter Table 10 with aircraft approach category being considered. Read across the table to determine minimum visibility for the appropriate light system.
STEP 4.	Establish ceiling values in 100-foot increments in accordance with paragraph 310.

Table 11. STANDARD CIRCLING MINIMUMS.

	Approach Category				
	A	B	C	D	E
Height Above Airport Elevation in feet	350	450	450	550	550
Visibility in Miles	1	1	1 ¼	2	2

Table 12. STANDARD ALTERNATE MINIMUMS.

Type of Approach Facility	Ceiling	Visibility
VOR, VORTAC, LOC, LDA, ASR, NDB	800	2
ILS or PAR	600	2

Table 13. STANDARD CIVIL TAKEOFF MINIMUMS.

Number of Engines	Visibility (Statute Miles)
1 or 2	1
3 or more	1/2

371. - 399. RESERVED.